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(54) **Microwave apparatus for clinical hyperthermia in endogenous thermotherapy.**

(57) A microwave apparatus for clinical hyperthermia in endogenous thermotherapy comprises a radiofrequency electromagnetic energy generator (1), an applicator (3) comprising a ridged conical-horn antenna (31) for administration of the electromagnetic energy, a skin temperature sensor (4) comprising insulating and preamplifying means (41), a bag (32) waterproof connected to the radiant opening of the antenna (31) and made of flexible

dielectric material transparent to radiofrequency signals up to 500MHz and containing a thermoregulatory fluid with forced circulation and adjustable temperature and pressure; a control unit (6) comprising a microprocessor, an operator panel (82) and a personal computer (9), if any, for setting, control, processing and display of the processing data and driving of the peripheral elements.

TABLE I

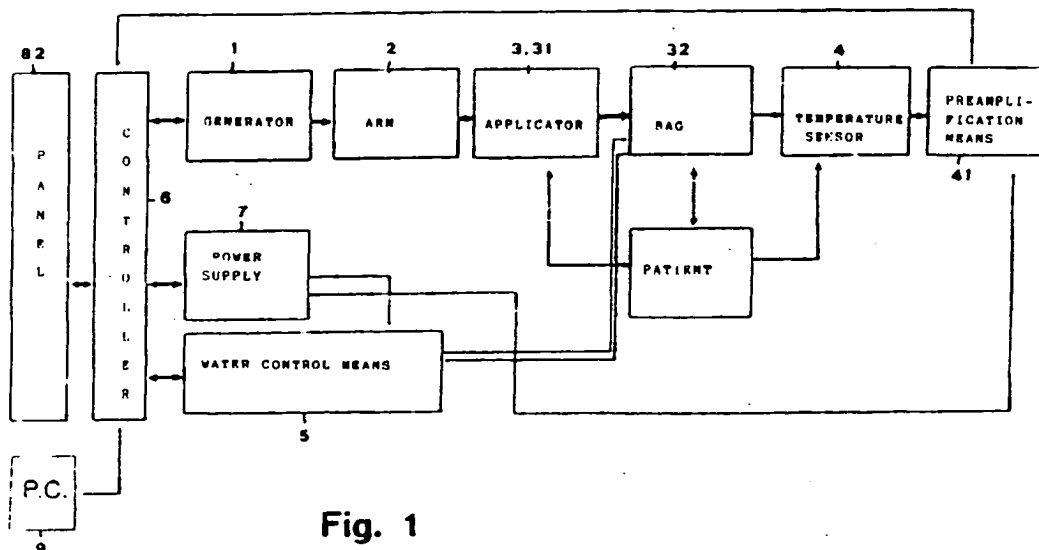


Fig. 1

FIG. 3 shows a thermal profile of tissues subjected to treatment without the surface temperature control, and

FIG. 4 shows the thermal profile of similar tissues subjected to treatment with an apparatus in accordance with the present invention with the surface temperature control.

Reduced to its essential structure and with reference to FIGS. 1 and 2 an apparatus for hypothermal microwave endogenous therapy in accordance with the present invention comprises:

- a 434MHz radiofrequency electromagnetic energy generator 1 with a continuously controlled output power from 0W to 100W,
- an arm 2 for support and positioning of an applicator 3 with a ridged conical horn antenna 31 and a sealed bag 32 of flexible dielectric material transparent to radiofrequencies up to 500MHz and containing distilled water under forced circulation, means being provided for hydraulic and electromagnetic interconnections as well as jointing and self-balancing of the arm 2 to ensure the degrees of freedom necessary and to allow blocking of the applicator 3 in the selected position without need of fixing it to the patient,
- a skin temperature sensor 4, e.g. a thermocouple of the copper-constantan T type, equipped with an insulation and preamplification device 41,
- means 5 for circulation of water and pressure and temperature control thereof in the bag 32 in the range 37°C-42°C,
- controller 6 of the equipment with a microprocessor for processing of treatment data,
- a power supply 7 to supply all the voltages and currents necessary for the working of the various units while assuring insulation from the external power line,
- a boxed frame 8 mounted on pivoting wheels 81 containing the functional units 1,5,6,7 of the apparatus with an operator panel 82 for setting, control and display of treatment data.

In a preferred embodiment, control means 6 comprise data support means such as a read only memory (ROM) in which the characteristic thermal profiles of one or more body portions are memorised.

In another preferred embodiment an apparatus in accordance with the present invention is equipped with a personal computer 9 which constitutes the interface with the operator and allows increasing the processing efficiency, filing of treatment data for each patient and optionally providing for memorization of characteristic thermal profiles into the above data support means.

Working is as follows. The operator sets on the

panel 82 or by means of the personal computer 9 the maximum power and duration of the application. Then, on the basis of the temperature distribution to be obtained in depth, the temperatures of the skin and of the bag 32 are set, again on the panel 82 or by means of the personal computer 9. Indeed, as shown in FIGS. 3,4 the thermal profile of the tissues subjected to treatment depends heavily if the bag 32 is used (FIG. 4) or not (FIG. 3) and is also a function of the temperature of the water contained therein.

Then the arm 2 is moved with the applicator 3 so that the bag 32 adheres to the affected skin surface of the patient; in particular the flexibility of the bag 32 and the capability of control of the pressure of the water contained therein allows a complete mechanical adaptation between the applicator 3 and the skin surface.

During treatment the data set on the panel 82 are processed, (together with the skin temperature data coming through the thermometric unit 41 from the sensor 4 by the microprocessor belonging to the control means 6 and in accordance with a specific algorithm which allows for the typical thermal profiles in the tissues. By means of said processing the treatment parameters are controlled.

It is clear that when a personal computer 9 is used, it provides said processing.

Skin temperature is continuously checked by the sensor 4 and delivery of power is consequently controlled by the controller 6 to maintain the preselected temperature.

Among the functions performed through the panel 82, in addition to those mentioned of setting the treatment parameters and the usual ones of turning the apparatus on or off or starting and stopping treatment and indication of trouble if any, there are those of indication of congruence of the data set with predetermined limit values and indication of the power delivered and reflected. In this manner the operator can intervene appropriately to correct or change the setting and or position more effectively the applicator 3.

The assumed values of the treatment parameters with the apparatus which is the object of the present invention are for example:

- output frequency: 434MHz,
- power delivered: 0-100W,
- skin temperature: 38-40°C;
- temperature of thermoregulatory fluid: 37-42°C.

The microprocessor used is typically but not exclusively of the 8 bit type and is equipped with a 32 kbyte memory.

The apparatus proposed is realized in accordance with applicable safety standards for electromedical equipment and in particular for microwave therapy equipment.

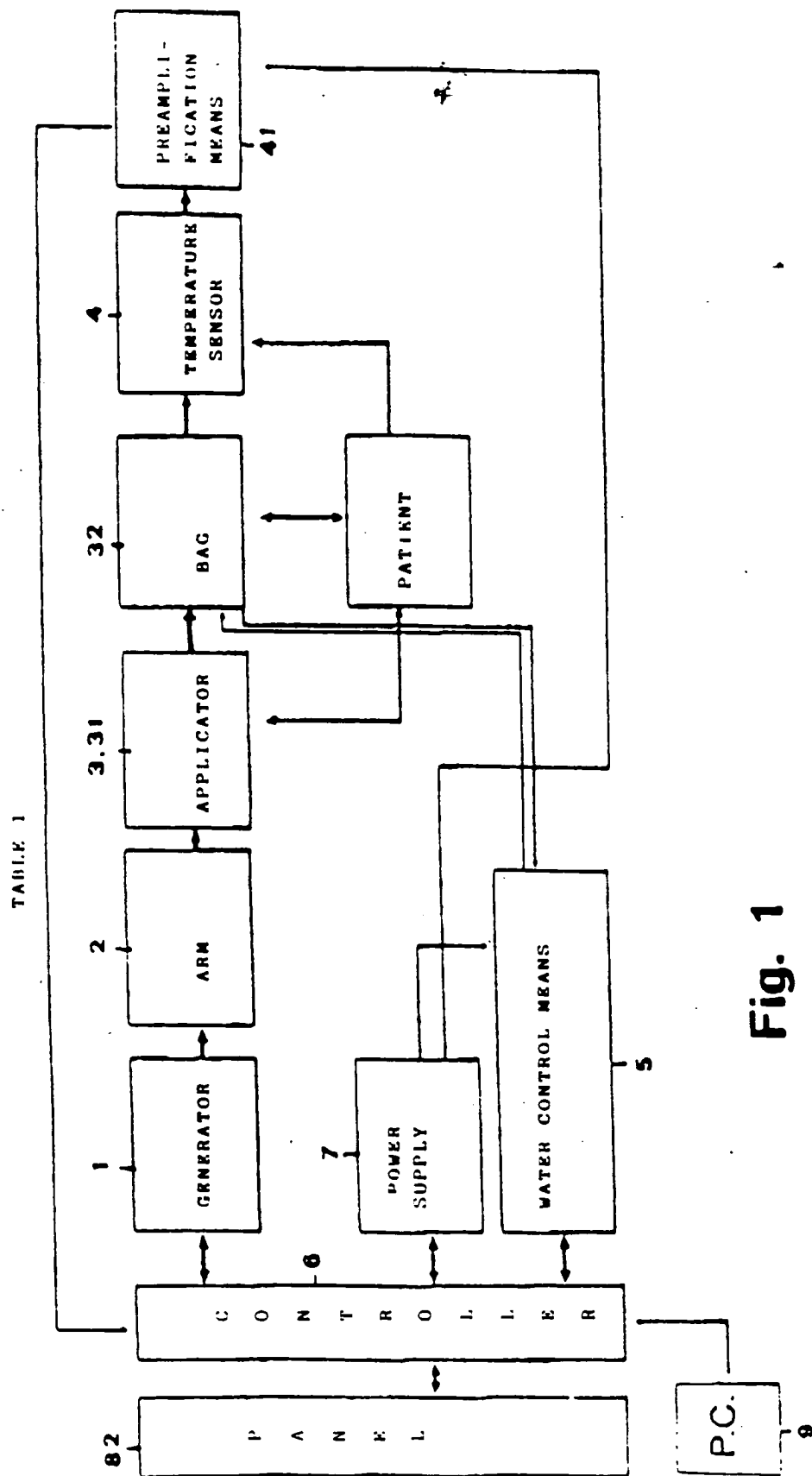


Fig. 1

TABLE 2

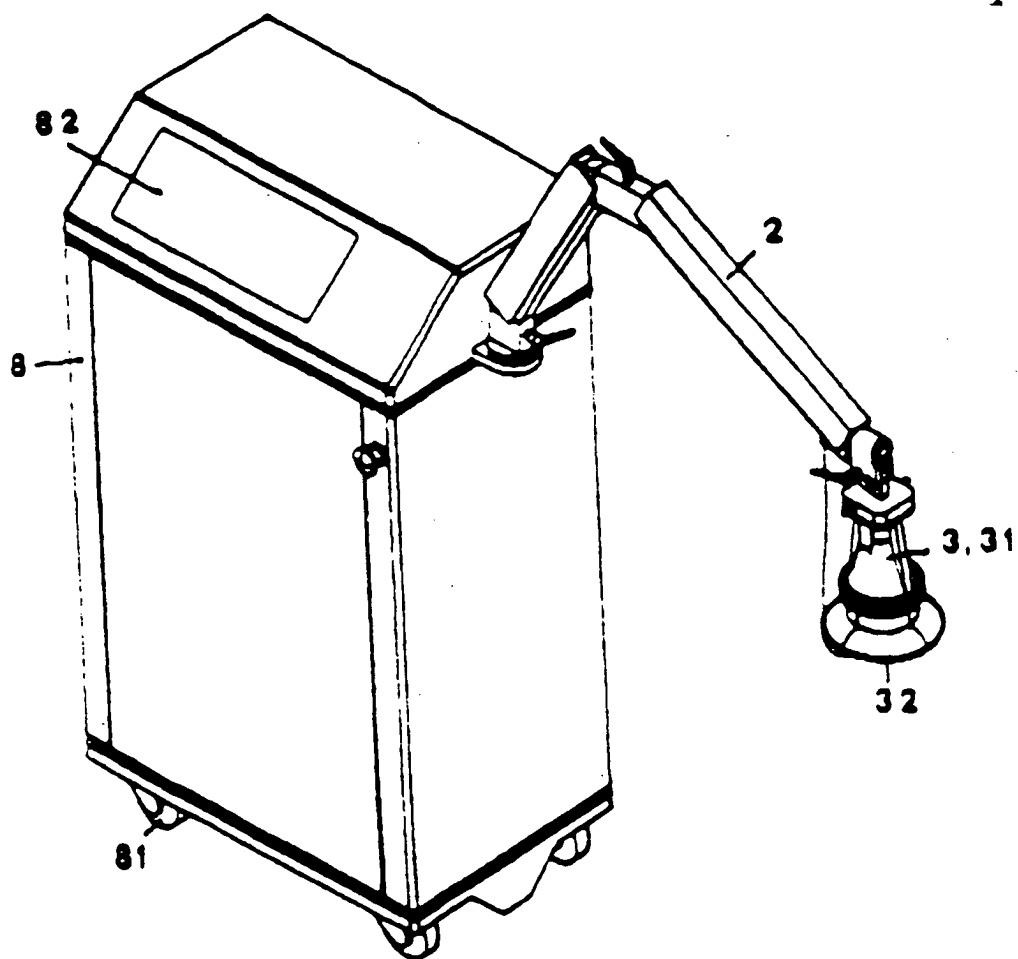


Fig. 2

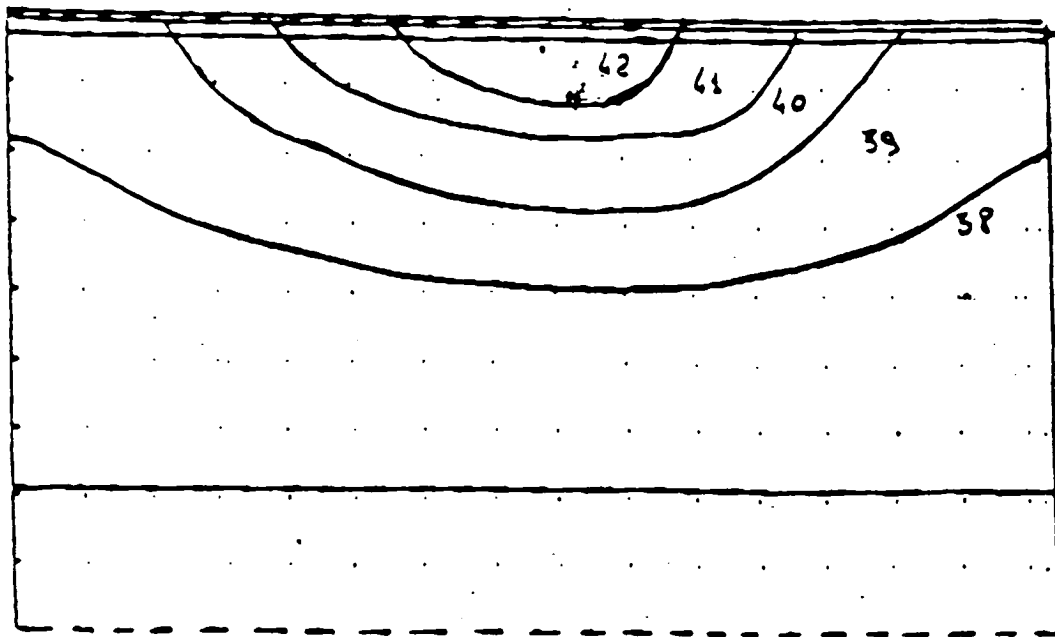


Fig. 3

TABLE 3

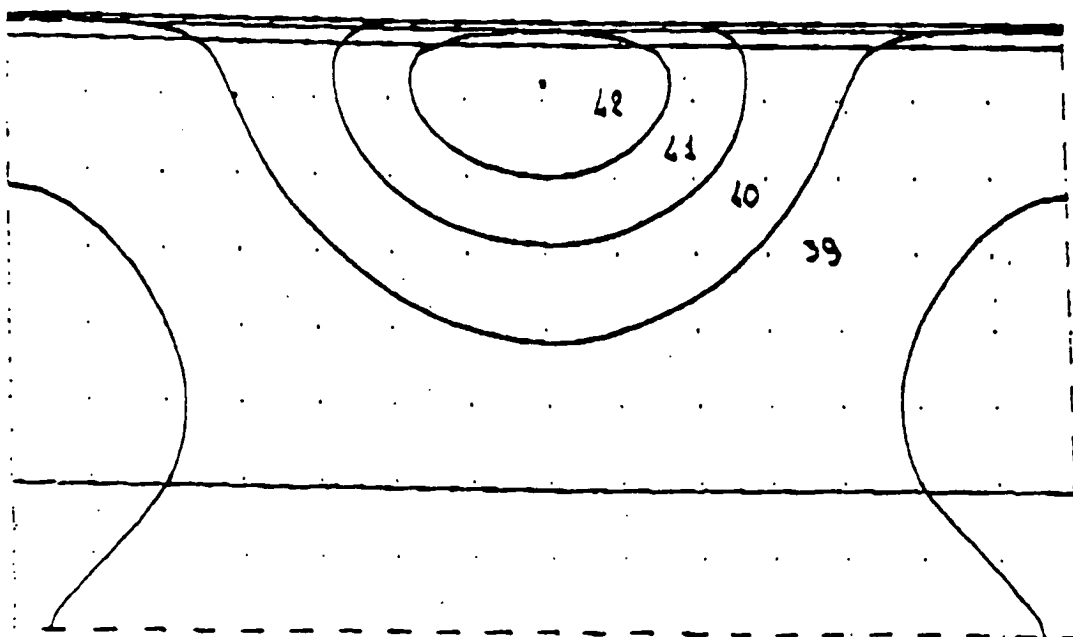


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number

EP 92 11 0202

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8 803 823 (BSD MEDICAL CORPORATION) * page 5, line 29 - page 6, line 32 * * page 13, line 28 - line 31 * * page 20, Table 1 * * page 23, line 3 - line 17 *	1-3,5-8	A61N5/02
Y	* page 14, line 26 - page 15, line 19 * ---	4	
X	US-A-4 884 580 (KIKUCHI ET AL.)	1,2,10	
Y	* column 2, line 64 - column 5, line 4 * ---	4	
X	EP-A-0 207 729 (BSD MEDICAL CORPORATION) * column 6, line 20 - column 7, line 24 * * column 15, line 30 - line 39 * ---	1,2,5,6	
A	US-A-4 891 483 (KIKUCHI ET AL.) * column 5, line 13 - line 68 * * column 7, line 13 - line 63 * ---	9-11	
A	DE-A-2 151 889 (ROBERT BOSCH ELEKTRONIK GMBH) * the whole document * -----	11	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			A61N
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 02 OCTOBER 1992	Examiner LEMERCIER D.L.L.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	